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(54) **Non-woven webs of synthetic fibres consolidated by means of carboxylated styrene-butadiene latices, and disposable articles made therefrom.**

(57) A non-woven web of synthetic fibre(s) is characterised by consolidating (optionally impregnating) the web (optionally a dry web) with a binder (optionally a sole binder) substantially comprising a polymer or a latex, provided by polymerizing:

from about 42 to about 68 parts by weight of a monoaromatic vinyl or vinylidene monomer which may be unsubstituted or substituted by a C_{1-4} alkyl radical, or a chlorine or bromine atom;

from about 30 to about 58 parts by weight of a C_{4-8} conjugated diolefin (preferably a C_{4-6} conjugated diolefin); and

from about 0.5 to about 8.0 parts by weight of a C_{3-5} ethylenically unsaturated monocarboxylic acid. The resultant web can have improved tensile strength in a cross machine direction.

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TITLE MODIFIED see front page

COVER STOCK

It is known to use synthetic fiber in the manufacture of non-woven webs. Such webs have a number of applications including the manufacture of disposable sheets, laboratory coats and cover stock for disposable diapers.

In manufacturing such products, there are a number of desiderata including the hand of the resulting web, the use of environmentally acceptable binders, the use of physiologically acceptable binders, and the processability of the web.

Carboxylated styrene-butadiene latices were originally proposed as binders for paper coating compositions. Such latices have been sold from the mid 1950's to the present time.

At about the same time, the art of impregnation of non-wovens recognised the use of latices of carboxylated styrene-butadiene polymers. This art generally requires the presence of a coagulating or cross linking agent such as an aluminate salt or an amine-aldehyde reinforcing resin.

This art has continued up to fairly recent times. United States Patent 2,868,754 issued January 13, 1959, to Gorman E. Eilbeck, assigned to The B.F. Goodrich Company, United States Patents 3,068,121 issued December 11, 1962, to Joseph R. Weschler, assigned to Johnson and Johnson, and United States Patent 3,720,562 issued March 13, 1973, to Arthur H. Drelich, assigned to Johnson and Johnson, are representative of this type of art.

United States Patent 3,256,234, issued June 14, 1966, to Verle A. Miller, assigned to International Latex and Chemical Corporation discloses the use of carboxylated styrene butadiene latices as binders for non-woven sheet material. The patent requires the use of from about 0.5 to 5 per cent by weight of dicarboxylic acids in the

polymer. The patent is extremely broad in that it covers polymer compositions containing from 20 to 90 per cent by weight of butadiene and from about 10 to 75 per cent by weight of a mono-olefinic monomer selected from the group acrylonitrile, styrene and methyl methacrylate.

Subsequent to the Miller patent, latices of polymers containing acrylate esters dominated the manufacture of non-wovens. This trend has continued and is illustrated by recent patents including U.S. Patent 4,268,546 issued May 19, 1981, to Schwartz et al, assigned to the Dow Chemical Company and Rohm and Haas European Patent Application 12,032, published 11.06.80.

Applicant has found that a latex of a polymer of a monocarboxylic acid monomer, styrene and butadiene with a specific composition has enhanced properties as a binder for webs of synthetic fibers. Such latices impart satisfactory wet tensile strength in both the machine direction and across the machine direction.

The present invention provides product web and a method of manufacturing a non-woven web of synthetic fiber(s), characterised by consolidating (optionally impregnating) the web (optionally a dry web) with a binder (optionally a sole binder) substantially comprising a polymer or a latex, provided by polymerizing:

from about 42 to about 68 parts by weight of a monoaromatic vinyl or vinylidene monomer which may be unsubstituted or substituted by a C_{1-4} alkyl radical, or a chlorine or bromine atom;

from about 30 to about 58 parts by weight of a C_{4-8} conjugated diolefin (preferably a C_{4-6} conjugated diolefin); and

from about 0.5 to about 8.0 parts by weight of a C_{3-6} ethylenically unsaturated monocarboxylic acid.

Preferably, the polymer is polymerized from a monomeric mixture comprising from about 57 to about 59

parts by weight of a monoaromatic vinyl or vinylidene monomer; from about 38 to about 40 parts by weight of a C_{4-6} conjugated diolefin; and from about 2 to about 4 parts by weight of a C_{3-6} ethylenically unsaturated monocarboxylic acid monomer. The preferred monomeric mixture comprises about 58 parts by weight of the monoaromatic vinyl or vinylidene monomer; about 39 parts by weight of a C_{4-6} conjugated diolefin; and about 3 parts by weight of a C_{3-6} ethylenically unsaturated monocarboxylic acid.

From a practical point of view, it is desirable that the solids content of the latex binder be as high as possible to minimize the water which must be removed from the non-woven web. In use, the latex may be compounded with conventional antioxidants, optical brighteners and fillers. The use of such compounding agents is well known to those skilled in the art. The compound may then be diluted or concentrated to achieve a solids content sufficient to consolidate the web. Examples of solids contents for the latex, or a compound of the latex, range from about 2.5 to about 55 weight per cent.

Examples of monoaromatic vinyl or vinylidene monomers are styrene and styrene derivatives substituted in the aromatic ring or in the vinyl radical by a C_{1-4} alkyl radical.

Some derivatives are α-methyl styrene, p-methyl styrene, and p-tertiary butyl styrene.

Examples of C_{4-8} conjugated diolefins are well known to those skilled in the art, e.g. butadiene and isoprene.

The ethylenically unsaturated monocarboxylic acid monomer contains from three to six carbon atoms. Some monomers are acrylic acid, methacrylic acid, crotonic acid, 2 pentenoic acid, 3 pentenoic acid, and hexenoic acid. The most commonly available acids are

acrylic and methacrylic acid.

The polymer may be prepared by conventional emulsion polymerization techniques which are well known to those skilled in the art. Aqueous monomeric emulsion(s) are prepared using surfactants which may be anionic or a mixture of anionic and nonionic surfactants. The emulsion is polymerized at temperatures up to about 85°C using redox or peroxide initiator systems. The polymerization may be conducted to a high conversion. Chain transfer agents and electrolytes may be present during polymerization. The resulting base latex is then stripped of residual monomer and compounded with conventional additives such as bactericide, fungicide, electrolytes, antioxidants and surfactants. The various ingredients used in polymerizing the base latex and compounding the final latex should be selected on the bases of minimizing irritation to the skin.

The resulting finished latex may be used per se as a sole binder or in combination with other known cobinders in e.g. saturating a web of non-woven synthetic fibers.

The synthetic non-woven web is then impregnated (e.g. saturated) with the latex or compound. Some methods are saturation, spraying, printing, foam bonding, etc. When required, excess latex or compound may be removed from the web by passing the impregnated web through squeeze rolls. The web is then dryed in a drying tunnel.

The amount of latex or compound used to impregnate the web is expressed as the percentage of the weight of latex or compound solids taken into the weight of the web. Usually web impregnation levels range from about 15 per cent to about 75 per cent. A preferred level of web impregnation is about 30 to about 50 per cent.

There are many types of synthetic fibers which may be

used to make the web. Some synthetic fibers are polyesters, polyamides and regenerated cellulose fibers. Polyesters are preferred.

The following examples are intended to illustrate the invention without restricting its scope.

A series of latices was prepared with a fixed ratio of styrene to butadiene, and 3 parts per hundred parts of monomer of an acid or a mixture of an acid and an acid anhydride.

The resulting latices were used to impregnate a polyester web weighing 1.0 oz/sq.yd (0.034 kg/sq.metre) at about 30 per cent latex solids. Measurements were made of the wet tensile strength of the web in the machine direction (MD) and across the machine direction (CMD). The results are set forth in the following table.

Carboxylic acid	Wet Tensile Strength			
	MD		CMD	
	lb/in.	kg/m.	lb/in.	kg/m.
Methacrylic acid	3.1	55.36	0.67	11.96
Acrylic acid	3.0	53.57	0.63	11.25
Itaconic acid	2.2	39.29	0.59	10.54
Mixture of 1.5 parts of Maleic anhydride and 1.5 parts Methacrylic acid	1.9	33.93	0.35	6.25

Two experimental latices were prepared from monomeric mixtures having the following approximate bulk composition.

Latex A	Styrene	-	53 parts by weight
	Butadiene	-	44 parts by weight
	Methacrylic acid	-	3 parts by weight
Latex B	Styrene	-	56 parts by weight
	Butadiene	-	41 parts by weight
	Methacrylic acid	-	3 parts by weight

The latices were compared with commercially available carboxylated styrene-butadiene latices and acrylic latices used as impregnants for non-woven polyester webs (1 oz/sq.yd.) (0.034 kg/sq. metre). The amount of latex used is expressed as the percentage of latex solids in the web relative to the weight of the unimpregnated web. Measurements were made of the tensile strength and elongation of the web in the machine direction and across the machine direction. The results are set forth in Table II.

Table II

Latex	Amount	Machine Direction			Cross Machine Direction		
		Wet tensile lb/in.	Wet tensile Kg/m.	Elongation	Wet tensile lb/in.	Wet tensile Kg/m.	Elongation
A	29.3%	4.0	71.43	46.3%	0.81	14.46	39.5%
B	31.9%	5.1	91.08	47.2%	1.25	22.32	47.2%
Commercial Acrylic	29.7%	4.9	87.50	39.5%	0.95	16.96	24.8%
Commercial carboxylated styrene butadiene	29.1%	3.3	58.93	40.3%	0.89	15.89	29.8%

A polyester web (1.4 oz./sq.yd.) (0.047 kg/sq.metre) was saturated with compounds of latices having the following polymeric composition:

Latex C -	Styrene	58 parts by weight
	Butadiene	39 parts by weight
	Acrylic Acid	3 parts by weight

and a commercially available acrylic latex.

The tensile and elongation of the resulting webs is given in Table III.

Table III

Latex	Pick-up %	CMD-Tensile Dry lb/in.	CMD-Tensile Dry Kg/m.	CMD-Tensile Wet lb/in.	CMD-Tensile Wet Kg/m.	Elongation % Dry	Elongation % Wet
Commercial Acrylic Latex C	19.6	0.51	9.11	0.32	5.71	50.6	26.1
	19.7	0.56	10.00	0.37	6.61	58.9	21.5
Commercial Acrylic Latex C	43.6	0.94	16.79	0.58	10.36	38.1	30.0
	44.0	1.03	18.39	0.70	12.5	48.2	40.3

A series of latexes was prepared from styrene, butadiene and methacrylic acid. The latices were used to impregnate a polyester web weighing 0.7 oz/sq.yd. (0.024 kg/sq.metre). The properties of the latex and the impregnated web are set forth in Table IV.

Table IV

St	Bd	MAA	Pick Up %	CMD Tensile Dry lb/in.	CMD Tensile Dry Kg/m.	CMD Tensile Wet lb/in.	CMD Tensile Wet Kg/m.
57	39	4	31.1	0.68	12.14	0.36	6.43
58	39	3	32.4	0.68	12.14	0.36	6.43
59	39	2	35.5	0.77	13.75	0.31	5.54
61	36	3	32.3	0.65	11.61	0.35	6.25
67	30	3	29.7	0.71	12.68	0.36	6.43
COMMERCIAL ACRYLIC			35.0	0.69	12.32	0.30	5.36

To illustrate the effect of the presence of a dicarboxylic acid in the latex, two latices were prepared. The latices were used to impregnate a polyester web weighing 1 oz/sq.yd. (0.034 Kg/sq.metre). The composition of the latex and the properties of the web are given in Table V.

TABLE V

St	Bd	MAA	Fumaric Acid	Pick Up %	CMD Tensile Dry lb/in.	Dry Kg/m.	Wet lb/in.	Wet Kg/m.
50	47	3	0	21.4%	1.2	21.43	0.6	10.71
49.87	46.98	3	0.25	21.4%	0.6	10.71	0.2	3.57

The presence of a dicarboxylic acid in the latex detracts from the properties of the impregnated web.

Claims

1. A method of manufacturing a non-woven web of synthetic fiber(s), characterised by consolidating (optionally impregnating) the web (optionally a dry web) with a binder (optionally a sole binder) substantially comprising a polymer or a latex, provided by polymerizing:

from about 42 to about 68 parts by weight of a monoaromatic vinyl or vinylidene monomer which may be unsubstituted or substituted by a C_{1-4} alkyl radical, or a chlorine or bromine atom;

from about 30 to about 58 parts by weight of a C_{4-8} conjugated diolefin (preferably a C_{4-6} conjugated diolefin); and

from about 0.5 to about 8.0 parts by weight of a C_{3-6} ethylenically unsaturated monocarboxylic acid.

2. A method according to claim 1, characterised by that said synthetic fiber comprises a polyester.

3. A method according to claim 1 or 2, characterised by that said monoaromatic vinyl or vinylidene monomer is in an amount from about 57 to about 59 parts by weight.

4. A method according to any one of claims 1 to 3, characterised by that said conjugated diolefin is in an amount from about 38 to about 40 parts by weight.

5. A method according to any one of claims 1 to 4, characterised by that said monocarboxylic acid monomer is in an amount from about 2 to about 4 parts by weight.

6. A method according to claim 5, characterised by that said synthetic fiber comprises a polyester, and said polymer or latex is derived from a monomeric mixture comprising

about 58 parts by weight of styrene;

about 39 parts by weight of butadiene; and

about 3 parts by weight of methacrylic acid.

7. A method according to claim 5, characterised by that said synthetic fiber comprises a polyester, and said polymer or latex is derived from a monomeric mixture comprising

about 58 parts by weight of styrene;
about 39 parts by weight of butadiene; and
about 3 parts by weight of acrylic acid.

8. A non-woven web, characterised by being provided by a method according to any one of claims 1 to 7.

9. A non-woven web of synthetic fiber(s), characterised by being impregnated with a binder substantially comprising a polymer provided by polymerizing:

from about 42 to about 68 parts by weight of a monoaromatic vinyl or vinylidene monomer which may be unsubstituted or substituted by a C_{1-4} alkyl radical, or a chlorine or bromine atom;

from about 30 to about 58 parts by weight of a C_{4-6} conjugated diolefin; and

from about 0.5 to about 8.0 parts by weight of a C_{3-6} ethylenically unsaturated monocarboxylic acid.

10. A web according to claim 8 or 9, characterised by that said monoaromatic vinyl or vinylidene monomer is in an amount from about 57 to about 59 parts by weight.

11. A web according to any one of claims 8 to 10, characterised by that said C_{4-6} conjugated diolefin is in an amount from about 38 to about 40 parts by weight.

12. A web according to any one of claims 8 to 11, characterised by that said monocarboxylic acid monomer is in an amount from about 2 to about 4 parts by weight.

13. A web according to claim 12, characterised by that said synthetic fiber comprises a polyester, and that said polymer is derived from a monomer mixture comprising:

about 58 parts by weight of styrene;
about 39 parts by weight of butadiene; and
about 3 parts by weight of methacrylic acid.

14. A web according to claim 12, characterised by that said synthetic fiber comprises a polyester, and that said polymer is derived from a monomer mixture comprising:

about 58 parts by weight of styrene;
about 39 parts by weight of butadiene; and
about 3 parts by weight of acrylic acid.

15. A web according to any one of claims 8 to 14, characterised by that said polymer is in an amount from about 15 per cent to about 75 per cent by weight of the unimpregnated web.

16. A web according to any one of claims 8 to 15, characterised by improved tensile strength in a cross machine direction.

17. Disposable sheets, laboratory coats, or cover stock for disposable diapers, characterised by being manufactured from a web according to any one of claims 8 to 16.